alterations in mineral balance, as has been brought out by the work of Bridge and Iob. Voluntary limitation of water intake is difficult to teach to children, and its enforcement in a large clinic throws too much dependence upon the self-control of the little patients. It has been shown that the ketogenic diet brings about a lessened intake of water equal to what can be accomplished with fluid limitation and with no persuasive effort.

The ketogenic diet has its percentage of failures, but it is the most successful single therapeutic measure today and it can be safely continued over a long time.

I agree with Doctor Nielsen that cases of Jacksonian epilepsy, in spite of their one-sided and focal manifestations, respond just as well to this treatment as the generalized, idiopathic type.

ACUTE PERFORATED PEPTIC ULCERS*

A CLINICAL REVIEW OF ONE HUNDRED AND FIFTY-FIVE CONSECUTIVE PATIENTS TREATED SURGICALLY

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DISCUSSION *by Burns Chaffee, M. D., Long Beach; John Homer Woolsey, M.D., San Francisco; Thomas O. Burger, M. D., San Diego.*

ACCORDING to Watson,[1] the earliest account of a perforated gastric ulcer was presented to the Royal Society in 1729 by Christopher Rawlinson. In this country O'Hara [2] reported the first example to the Philadelphia Pathological Society in 1875. The first successful surgical excision of a perforated duodenal ulcer was reported by Dean [3] in 1894. Since that date an ever-increasing amount of literature has accumulated which crystallizes our thoughts as to early diagnosis and treatment.

The subject-matter for our present study was obtained from a careful clinical review of 155 consecutive patients with acute perforated peptic ulcer. These patients were treated surgically by the San Francisco Emergency Hospital Service.

What is the probable incidence of acute perforations among patients with a proven peptic ulcer? In 1911 W. J. Mayo [4] reported the occurrence of twenty-five perforations among a series of 272 proven peptic ulcers (10.9 per cent). Trout [5] in 1928 reported a definite increase in acute perforated ulcers among the enlisted men of the United States Army stationed at Hawaii. The incidence increased from one in forty-one (2.5 per cent) in 1922 to one in seven in 1926 (14.4 per cent). Such statements show that the danger of perforation is a factor of considerable importance.

CENSUS OF THE GROUP

This disease is found most frequently in the lower social scale of life, for these individuals as a class are less likely to have proper dietary and medical supervision for their indigestion. This type of patient also is more likely to have poor oral hygiene, and other foci of infection.

Perforated peptic ulcer may occur at the extremes of life. Cecil Finney reports a case in an infant two months old. Our oldest patient was a man of seventy-two years of age. Our series shows the disease to be one of early adult life. The average age was forty years, while about 60 per cent of the patients were in the third and fourth decades of life. Ninety-five per cent of the patients in our series were males.

FACTORS PROBABLY CONTRIBUTING TO THE CAUSE OF ACUTE PERFORATION

1. *Family or Individual Predisposition to Development of Ulcer.*—Among our patients there were three instances where other members of the family had acute perforated ulcers. Two patients reported in this series have each had three emergency operations for this same disease.

2. *Septic Foci and Upper Respiratory Infection.*—It was very noticeable that the majority of these patients had poor oral hygiene, which many investigators believe to be an initiating or aggravating factor in the disease. Of equal significance was the apparent seasonal variation, for 70 per cent of our patients were admitted during the six-month period of winter and spring when acute upper respiratory infections are most prevalent.

3. *Improper Dietary and Medical Supervision.* The social status of these patients as a group precludes satisfactory dietary regimen and intelligent medical supervision of their ulcer problem.

4. *Indiscretion of Diet and Alcoholism.*—In many patients of this series, perforation occurred immediately following an eating or alcoholic drinking orgy. One patient suffered perforation after complying with a fake ulcer "cure" which consisted of a twenty-one-day fast broken by the ingestion of one gallon of milk.

5. *Sustained Physical Effort.*—There seems to be some relation between sustained physical effort and exacerbation of ulcer symptoms and perforation. In several patients of this group, perforation occurred suddenly during the hard physical exertion required by their occupation, but they were unsuccessful in contesting their cases before the Industrial Accident Commission.

CLINICAL PICTURE

Each of us no doubt can recall vividly our first patient suffering from acute perforated peptic ulcer. The initial symptoms and signs may be reviewed by quoting Moynihan's accurate and vividly expressed observation of the catastrophe:

"When perforation occurs there is a sudden onset of the most intolerable agonizing pain. The pain is hardly exceeded in severity by any that a human being can suffer; the extremity of agony is reached. So profound may the instant impression be that death results. . . . The patient is always prostrate with agony; the eyes are wide and watchful; beads of sweat stand out upon the brow and the lines are quickly graven on the cheeks. The patient breathes shortly and quickly; he cannot take a deep inspiration. . . . the attempt to do so ends in a groan or shout of agony and a spasm of pain. The answers to one's questions are given in snatches and every expiratory phase ends

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abruptly in a catch. . . . It will be found that the abdominal wall is tight; it is held with a rigidity that never for one moment slackens."

HISTORY

Of what significance is the history of previous peptic ulcer? The majority of these patients will give a history of previous indigestion of varying intensity over a variable length of time. In our own series of 155 patients we were able to elicit a history of some indigestion in 122, or 80 per cent, although many of this group gave a history absolutely negative for peptic ulcer when questioned immediately before surgery. During the agony of the acute attack many of the patients discount entirely or greatly minimize any previous discomfort from indigestion. Hence very often we find the immediate preoperative history surprisingly negative. Of still more significance is the fact that thirty-three of our patients, or 20 per cent, even in the calm of convalescence could recall no symptoms even suggestive of peptic ulcer. That is to say, the acute perforation was the first indication of ulcer. We cannot stress too strongly this well established clinical fact: that a very considerable number of these patients will give a history absolutely negative for ulcer. The physician's apparent lack of knowledge of this fact probably accounts for most of the serious and oft-times fatal errors in diagnosis.

PROGRESS OF THE DISEASE

Probably no other disease develops with such dramatic suddenness as does acute perforated ulcer. This disorder is unique also in that after a few hours a reactionary period develops and the diagnosis often becomes confusing. If an error in diagnosis still is made, the picture gradually develops into one of advanced general peritonitis. These three phases of the disease will be discussed.

First Stage.—The first stage is that of onset or primary shock which usually lasts from one to two hours. During this period the patient complains bitterly of constant, agonizing, knife-like pains which begin in the epigastrium and rapidly spread over the abdomen. The pains usually are referred to one or both shoulders, to the infraclavicular regions, or around the costal margins. Physical examination at this period reveals essentially those findings observed in primary shock. The skin is cold and clammy, the pulse weak, and the temperature usually is subnormal. There is a moderate leukocytosis and an increase in polymorphonuclear elements. The respirations are jerky, shallow, and thoracic in type, and a deep inspiration usually ends in an expiratory grunt and an exacerbation of the pain. Palpation of the scaphoid-shaped abdomen reveals a complete general rigidity of the abdominal muscles. The term "board-like rigidity" describes well the condition which is almost pathognomonic of this disease in its early stages. Other evidences of general peritoneal irritation are present, such as abdominal, rectal, and "rebound" tenderness.

Nausea and vomiting occurred in 13 per cent of the patients of our series. In most cases the vomiting was nonproductive, but in others the vomitus showed bile or gastric contents. In but two cases was coffee-grounds vomitus recorded, and in no instance was there hematemesis or melena.

Second Stage.—The second stage or reactionary period usually develops between two and twelve hours after the onset of perforation, and is the period when the patient usually first comes under medical observation. He still complains of abdominal and referred pains, but they are less severe. The alarming evidence of primary shock is less noticeable for there is an apparent improvement in the general status of the patient. The temperature and the laboratory findings are essentially those of the first stage. There is, however, the clinical picture of an acute peritonitis resulting from contamination of the abdominal cavity by the gastric content and acid chyme. Also there are the superimposed symptoms and signs of an acute pneumoperitoneum. The anatomical landmarks such as lumbar gutters, roots of mesenteries, etc., help to determine the nature and direction of the spreading peritonitis. Hence, after several hours, we are very likely to find the signs of peritonitis localized to the right lower quadrant, and an erroneous, and often fatal, diagnosis of acute appendicitis is made, the real pathologic changes not being suspected or recognized. Occasionally the peritonitis is so localized to the right upper quadrant that a diagnosis of acute cholecystitis is made, and proper immediate operation is deferred. In any instance where the diagnosis is still in doubt, an x-ray film taken with the patient in a sitting posture usually will reveal the presence of a pneumoperitoneum. In several instances this very valuable diagnostic aid has been most helpful to us in arriving at the correct diagnosis. (The importance of these findings has been stressed by Vaughan and Singer,[6] who report a correct diagnosis by this means of 87.5 per cent in a series of seventy-two proven perforated peptic ulcers.)

The physical examination of this second period is otherwise essentially that described in the first stage. The rigidity may be more localized to the epigastrium, the right upper or the right lower quadrant of the abdomen. Percussion often reveals a diminished liver dullness and some evidence of shifting dullness in the flanks.

Third Stage.—The third or final stage develops insidiously after twelve hours and presents the typical picture of a progressive general peritonitis with the associated paralytic ileus. The very high mortality of patients first treated in these late stages is, of course, the mortality of late neglected peritonitis.

DIFFERENTIAL DIAGNOSIS

What are the errors of diagnosis which are most likely to confuse the picture and hence delay the urgent surgical treatment which is necessary? In our experience, acute inflammation of the gallbladder, of the appendix, and of the pancreas have simulated most frequently the physical examination and findings during the second stage of the disease. The probable reason for this similarity we have already considered. Occasionally an early

intestinal obstruction also will give similar findings. Likewise, we have had several instances of acute severe alcoholic gastritis in noncoöperative patients which have simulated very closely the abdominal findings of acute perforated peptic ulcer. The x-ray examination referred to has given us the correct diagnosis in most of these problems, while in others, fortunately, an early exploratory laparotomy revealed the pathologic changes present.

PROPHYLAXIS

The prophylaxis of this disease should of course be directed toward eradicating all possible etiologic factors which are said to cause or aggravate peptic ulcers. These efforts should include careful attention to foci of infection, dietary and medical regimen. This same therapy should be given to our ulcer patients following operation in order to minimize the tendency to recurrence, which is so prevalent.

TREATMENT

The treatment of the acute perforated ulcer by immediate surgery is universally accepted as the method of choice. Delayed diagnosis or temporizing measures in this clinical entity is, as Cope [7] says, "equivalent to a death sentence with very slight chance of reprieve." It is true, however, that perhaps a small number of these patients might survive if intelligent, conservative therapy were instituted promptly. With such a precarious line of treatment, we are gambling that the ulcer will become sealed automatically, as it does occasionally, to the undersurface of the liver or adjacent viscera. We have had the opportunity to see several such patients make a complete and rapid recovery without surgery. Accordingly, we must not be too dogmatic and pessimistic in our prognosis to those patients who refuse proper surgery on account of ignorance or religious (?) scruples.

Type of Anesthesia.—These patients as a class are excellent surgical risks if operated upon within twelve hours, irrespective of the type of anesthetic used. As soon as anesthesia is established, the pulse usually improves and the patient will tolerate well any major gastric surgery contemplated. Where there are no contraindications to its use, we use spinal anesthesia as the anesthetic of choice. The complete relaxation obtained by its use has shortened the time needed and has facilitated both operation and closure.

SURGICAL PROCEDURES

1. *Pathologic Changes.*—Upon opening the abdomen through an upper right rectus incision there is usually an escape of air under tension. The peritoneum is injected acutely and the abdominal viscera are bathed in a large amount of bile-stained, mucoid transudate. As 95 per cent of peptic ulcers are located near the pylorus, this region is explored first. The lesion usually is recognized easily as a perforated peptic ulcer which is surrounded by fresh fibrinous exudate. The size and chronicity of the ulcer found will bear a direct ratio to the duration of clinical symptoms. Fortunately, in most instances perforation occurs when the stomach is empty; hence the cultures are not grossly contaminated and are frequently sterile. The pathologic picture presented is essentially that of an early chemical peritonitis with an associated acute transudate.

2. *Type of Operation to Be Performed.*—We feel that during the first eight-hour period the patient is usually well able to stand major gastric surgery if such be indicated. After this period surgeons agree that simple closure of the ulcer is the operation of choice.

There seems to be a growing tendency to do a routine simple closure even in the earlier period. With many of our patients so treated, the final results were most satisfactory. The rationale of such a procedure is evident when we consider the relative frequency of recurrence of ulcer symptoms after all types of gastric surgery. Is it not probably better surgical judgment to do the simplest procedure first and reserve the more radical surgery for a second attempt when the patient can be studied and prepared more carefully?

The chief indications for more radical surgery, such as pyloroplasty or gastro-enterostomy, are in those patients in whom simple closure might cause a pyloric obstruction, either immediate or remote. With our patients the pyloroplasty done in most instances included an excision of the ulcer. The closure was made usually with inverting double mattress sutures of fine chromic catgut, and the line of closure further reinforced with the gastrohepatic omentum.

The advocates of simple closure alone have much in their favor, for such a life-saving procedure can be done in a few minutes by even a novice in surgery, whereas an attempt to do the more radical operations might jeopardize the patient.

In our series there were sixty-seven simple closures, thirty-three pyloroplasties, and fifty-five gastro-enterostomies.

In this entire group of patients no intraperitoneal drainage was used. We are convinced that drainage of the abdominal cavity, at least in this type of peritonitis, is contraindicated and that the drain serves only as a foreign body which produces intra-abdominal adhesions. (We do, however, drain the abdominal wound routinely.)

Postoperative Treatment.—We have found that the satisfactory convalescence was aided if nothing was given by mouth for forty-eight hours; after that time an increasing diet was given, up to a modified Sippy type at the end of two weeks. During the first forty-eight hours glucose (10 per cent, given intravenously, and saline infusions maintained the fluid intake. During this same period a nasal tube apparently lessened the tendency to nausea and gastric dilatation. Upon discharge from the hospital these patients should be warned of the dangers of recurrence, and should be advised of the principles of prophylactic therapeutics.

Mortality and Cause of Death.—Probably in no other disease is early diagnosis and immediate

surgical intervention so essential to a favorable prognosis.

In our series of 155 patients there was a gross mortality of 25 per cent. Of 117 patients who were operated upon within ten hours after perforation there were fifteen deaths or a gross mortality of 13 per cent. There were thirty-eight patients operated upon more than ten hours after onset of acute perforation, with a gross mortality of 64 per cent. This very significant increase of gross mortality from 13 to 64 per cent, of course, is the high mortality of delayed treatment.

The causes of death were as follows: peritonitis, 50 per cent; pneumonia, 20 per cent; cardiac disease, 30 per cent. The relative high mortality in this type of gastric surgery is in a large measure the result of such complications, which are so common among those patients who are in poor health from dissipation or disease.

CLINICAL RESULTS

We have been able to follow the postoperative course in 46 per cent of patients in this series and our results may be summarized as follows:

1. Eighty-five per cent of the patients reported themselves either entirely free of ulcer symptoms, or evidences of recurrences were promptly controlled by dietary measures.

2. The incidence of recurrence of ulcer symptoms was about the same after each type of operation performed. We do note, however, that simple closure of the recently developed acute ulcer generally effected a cure. Such a procedure with the more chronic callous ulcer, however, was not sufficient, and further medical or surgical care was the rule.

3. Those patients who reported a return of ulcer symptoms were almost invariably guilty of gross neglect of the various prophylactic measures outlined above.

4. The recurrence or persistence of ulcer symptoms is occasionally the result of multiple ulcers which were not searched for at the time of the emergency operation.

5. X-ray examination usually will show a persistent deformity of the duodenal cap after operations in this area, even though the patient is free of symptoms. Accordingly, proper evaluation of these findings is very essential in any follow-up studies of these patients.

6. We are convinced that the best ultimate results of any gastric surgery will be among those patients who receive the most careful medical supervision of their ulcer problem.

SUMMARY

1. The incidence and danger of perforation is a very important factor in the ulcer patient.

2. Acute perforation is most prevalent among those individuals who have improper management of their peptic ulcer problems.

3. A negative preoperative ulcer history is a very common observation.

4. An acute perforation was the first clinical evidence of the presence of a peptic ulcer in 20 per cent of the 155 patients reported in this series.

5. The clinical history, physical findings, and differential diagnosis are discussed.

6. Immediate laparotomy with closure of the perforation is the treatment of choice.

7. If operation is done within eight hours after perforation these patients are usually excellent surgical risks and major surgery is tolerated well.

8. If operation is done later than eight hours after perforation, simple closure alone is indicated.

9. Drainage of the abdominal cavity was not used in any operation of this series.

10. The mortality of this disease is essentially the mortality of delayed surgery with resultant peritonitis.

11. Follow-up records of the patients in this series show that with reasonable dietary care 85 per cent of satisfactory cures can be expected after all types of gastric surgery.

12. The type of the operation performed does not seem to influence the incidence of recurrence in comparable cases.

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DISCUSSION

BURNS CHAFFEE, M. D. (406 Professional Building, Long Beach).—The keynote of this paper is the importance of early diagnosis of acute perforated peptic ulcer. With all the accumulated knowledge we have of acute abdominal conditions, we have not lowered the death rate of these patients very materially. The chief reason is that early diagnosis is not made, or that the patient or the relatives will not coöperate with the attending doctor. Usually the diagnosis is not difficult. However, in questionable cases there should be no delay in sending them to the hospital where a flat roentgen-ray plate of the abdomen may be taken and a diagnosis thereby determined. Conservative surgery merits the best results. The essayists report gratifying results. Their percentage of cures is considerably higher than most writers', and I ascribe this to their conservative surgery, painstaking postoperative treatment and follow-up care. The latter is extremely important and not infrequently difficult to have carried out, as the greater percentage of this class of individuals are difficult to educate. The subject of drainage usually provokes discussion. The old version, "When in doubt, drain," is being replaced by a new version, "When in doubt, do not drain." Drainage in these cases is not a life saver and its use should be discouraged. Occasionally an abscess in the pelvis develops and in such cases the necessary drainage can be established.

JOHN HOMER WOOLSEY, M. D. (490 Post Street, San Francisco).—The profession is quite well educated to the recognition of symptoms and signs of a perforated peptic ulcer, but now and then delay in order to make an exact diagnosis jeopardizes the patient's chance of recovery. Many of such patients are too sick and suffering too severe pain to give reliable histories. An acute onset of severe pain and the rigid board-like abdomen are sufficient for a diagnosis of, first, an "acute surgical abdomen," and the more refined diagnosis will follow in 75 per cent of instances. A plain roentgen-ray with the patient in a sitting or standing position, as recommended by the authors, is worth while when in doubt. Do not let us delay when there is evidence of the "acute surgical abdomen." When in doubt give the patient the best chance of recovery, and that is direct inspection by laparotomy.

In this paper we are particularly interested in the types and results of treatment. The class of patients who fall to a free city emergency service are usually a malnourished type. Therefore the general resistance will run low and influence the authors' statistics, especially in those instances where operation was delayed to ten hours postrupture. However, I would heartily endorse what they recommend, single closure preferred; but if this is likely to give obstruction to the progress of the meal, then an accompanying gastrojejunostomy. In the acute perforation, characterized by a simple puncture and no accompanying visceral wall induration, simple closure by approximation and inversion as a rule is sufficient. In perforation of an old ulcer, then, the visceral wall induration closure may lead to too much intrusion upon the lumen, and then a gastrojejunostomy is in order. Any pyloroplasty (and the only one of certain enduring benefit is the Finney type) is as a rule contraindicated, for one should avoid fresh incisions in and through an inflamed area.

In the postoperative care I have never found that water in small sips, starting twelve hours postoperatively and in increasing amounts thereafter, has ever interfered with healing or been accompanied by any more likelihood of stasis. On the contrary, I believe this fluid by mouth has been of added comfort to the patient.

The authors' recommendation of nonperitoneal drainage is, in my opinion, wise, but I believe that, as a rule, drainage of the abdominal wound should be employed.

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THOMAS O. BURGER, M. D. (1301 Medico-Dental Building, San Diego).—Ruptured duodenal ulcer is one of the very dramatic surgical conditions where prompt surgery, with very few exceptions, will save more lives than any other comparable intra-abdominal condition. Most of these cases are seen by the general practitioner first, and at the present time the majority of the profession are alert and members of our organization appreciate the urgency of this need of immediate surgery; but, as we know, there are a great many irregulars, nonmembers of medical organizations, religious, or other type that do not recognize or, if they do recognize, do not give these people the benefit that they deserve in the way of immediate attention. It is proved well in this paper, and in other discussions and statistics, that hours of delay means an increasing number of deaths, and the doctor who has the force and ability to persuade these patients or their family to an immediate operation is the benefactor. Fortunately the majority of these people are in such intense agony that they are easily persuaded to go to a hospital, when on other occasions they may be very difficult subjects to persuade. The doctor who repeats his hypodermic of morphin until he produces sufficient ease to allow these patients to go into this second stage or "phase," as it is described in this paper, often loses that golden opportunity of getting the patient at the opportune time.

Ruptures that are quickly protected by surrounding viscera or omentum and held from spreading are not of the outspoken, bold, clinical type that occurs in the vast majority, and their diagnosis is frequently very difficult from other intra-abdominal conditions. Occasionally extra-abdominal conditions as coronary occlusion may suggest very strongly a ruptured duodenal ulcer, but considering their infrequent occurrence and delay incident to diagnosis, this in ninety-odd per cent of the cases is hardly a question when board-like rigidity, shock, and agonizing epigastric pain are present.

Immediate exploration, closing the ulcer, unless there is a very decided induration of the visceral wall, by simply closing the ulcer and vulcanizing a patch of omentum thereon is all that is necessary in probably over 90 per cent of the cases, and intra-abdominal drainage is not usually indicated. Recurrence does occur, as perforation occurred the second time in a patient of mine, but that is a rare case.

Gastro-enterostomy or pyloroplasty has its indications, but in the vast majority of cases I think our reports and statistics show that the extra risk of surgery at this particular time, when all conditions are not so favorable, will be more fatal probably than that later fatality resulting by not doing the operation.

These patients should be followed up carefully, and if symptoms and roentgen-ray findings indicate the recurrence of an ulcer, then more radical surgery can be performed at a more opportune time.

I agree with the authors that spinal anesthesia is extremely desirable in this class of cases. The one disadvantage in rupture of some viscus in the lower abdomen on account of the low head position is not objectionable here because our trouble is in the upper abdomen. Cleansing of the peritoneum is much easier, the operation can be done more rapidly for the repair is easier, and in most instances is more desirable from every standpoint. Patients seen in the very late stages of peritonitis are a serious problem. Often, as has been stated so well in this paper, it is a chemical or a mechanical irritation peritonitis rather than of the septic type. By the institution of the customary treatment for peritonitis, *viz.*, Fowler's position, duodenal drainage, fluid balance, etc., until localization takes place, probably is as great a life-saving treatment as we know.

FRACTURES OF THE FOREARM*

A SIMPLE METHOD OF HANDLING BY MEANS OF WIRE TRACTION

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DISCUSSION *by H. W. Spiers, M.D., Los Angeles; Alfred Edward Gallant, M. D., Los Angeles; Douglas D. Toffelmier, M. D., Oakland.*

THE purpose of this paper is to present a simple and efficient method of handling difficult fractures of the forearm, meeting the two constant requirements in the treatment of any fracture—good reduction and uninterrupted fixation until bony union takes place. By difficult fractures, I mean compound fractures and those cases which cannot be treated successfully by the ordinary, conservative means of handling fractures of the forearm.

METHOD OF PROCEDURE

The procedure is carried out under a general anesthesia in the operating room, and the same precautions are observed as in any major operation. The lower third of the arm and entire forearm, including the fingers, are prepared in

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